NASA TECH BRIEF
Goddard Space Flight Center

Right Angle Mounted Cold Trap

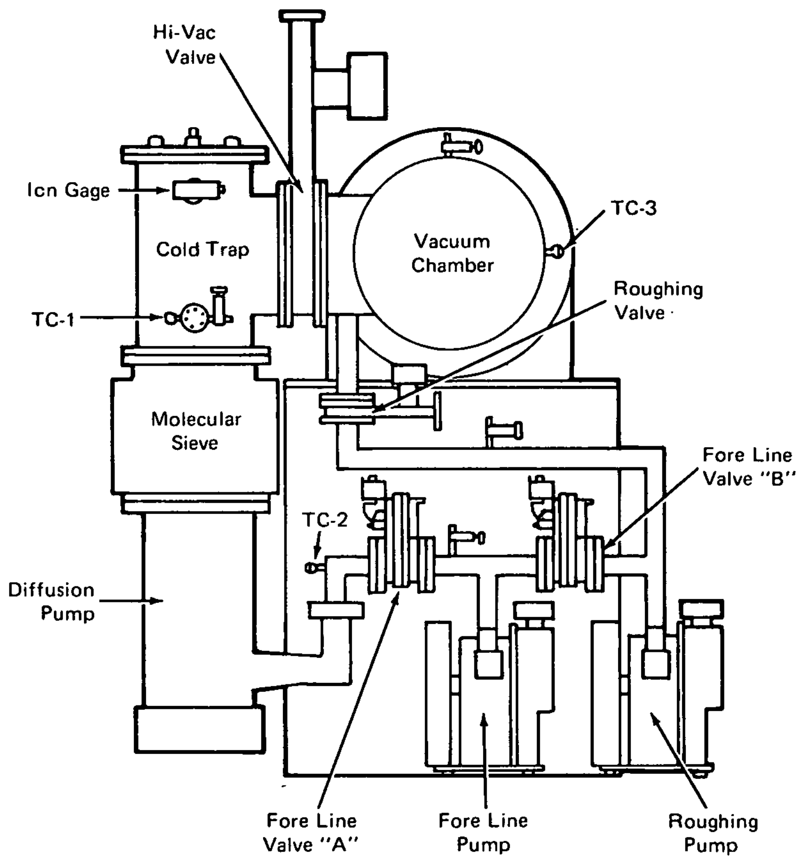

Figure 1. A diagram of the vacuum system showing the location of the cold trap assembly.

The problem:

A cold trap that can rapidly lower pressure and hold it there long enough for overnight operation was needed in a vacuum system which is used to calibrate, align, and check a number of solar research instruments.

The solution:

A highly efficient right-angle-mounted cold trap has been designed; space in a side pumping vacuum system, which is normally occupied only by an empty elbow, is efficiently utilized in this configuration. This cold trap has the following properties:

(1) It allows for the installation of a molecular sieve and diffusion pump without raising the working level of the chamber.
(2) It quickly lowers the pressure of the system when liquid nitrogen is added.
(3) It has sufficient reservoir volume for holding liquid nitrogen at the active level for a minimum of 13 hrs.

(continued overleaf)

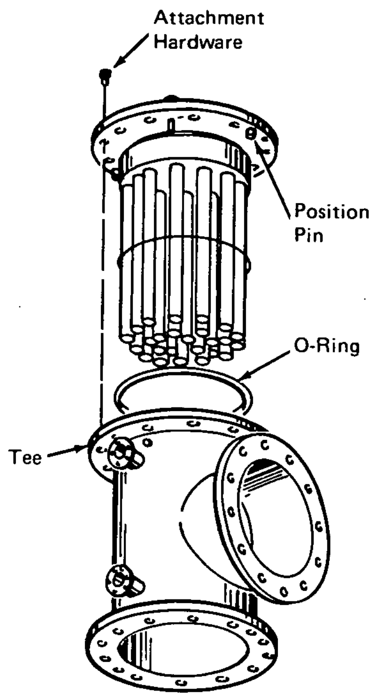

Figure 2. Exploded view showing the assembly of the cold trap.

(4) It is easy to load with liquid nitrogen.
(5) It is maintenance free.
(6) It can bring the pressure in the chamber down to a minimum of 2 X 10^{-9} Torr.

How it's done:

To keep the vacuum chamber at a convenient working height, the pumping port is placed on the side of the vacuum chamber (see Figure 1) instead of on the bottom as is often the case. In this configuration a molecular sieve can be installed above the diffusion pump, and sufficient space remains for the inclusion of a cold trap. This requires the housing of the cold trap to be in the shape of an elbow or a "tee". The "tee" shape is selected for simplicity of assembly and installation. The entire cold trap assembly is constructed of type 304 stainless steel, and all interior surfaces are polished to a number 7-8 mill standard. The material and finish provides a system that is extremely low in outgassing properties.

The overall height of the unit is 57.8 cm; the interior diameter of the vertical section is 29.9 cm; and the entrance port flange is 25.4 cm from the center of the vertical section. Flanges are a minimum of 19-mm thick, and the wall thickness of the tee is 3 mm. Incorporated in the body of the cold trap tee are two flanges to accept a thermocouple gauge and an ion gauge.

The interior of the cold trap (see Figure 2) has 21 chill tubes which are 25.4 mm in diameter with 0.8-mm thick walls. These tubes are attached to the base of a reservoir which in turn is supported from the mount flange by means of three 6.5-mm diameter vent tubes and a 25.4-mm diameter fill tube. These four supporting assemblies are of double tube and cap construction. This method establishes a long thermal path, and the vacuum present in the system is used to its advantage to assure a minimum of heat exchange. The center tube assembly has a tube which extends beyond the cap and is used in filling the cold trap with liquid nitrogen.

The 21 chill tubes are arranged to present an optically dense path to the wall opposite the entrance port. The widest spacing is used near the entrance port so that the restriction to flow in this area will be held to a minimum. To assure proper orientation in assembly, two pins of different size diameters are used in the mount flange, and corresponding holes are placed in the tee flange.

Very high conductance is achieved in this design since the total cross-sectional area of obstruction for the 21 tubes is slightly more than 15% of the cross-sectional area of the tee. At the same time a large cold surface area is provided: 8929±25 cm^2.

The reservoir is placed at the top of the tee, in dead space and not in the flow path. A single charge of liquid nitrogen (9737 cm^3) accounts for nearly 25% of the volume of the vertical section of the tee. A single liquid-nitrogen load, when charged at 2 X 10^{-5} Torr, has a holding time of 13 hrs. On charging at a pressure of 3 X 10^{-5} Torr, the pressure drops to 6 X 10^{-6} Torr in approximately 5 minutes. In the system described, a pressure of 1.5 X 10^{-9} Torr was achieved after 12 hours of pumping with the cold trap charged.

The cold trap can be fully charged with liquid nitrogen in about 10 minutes. The trap has been in maintenance-free use for more than five years and has been charged with liquid nitrogen approximately 500 times.

Note:

Requests for further information may be directed to:
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Reference: TSP 72-10436

Patent status:

No patent action is contemplated by NASA.

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